APPENDIX D – Special Controls

ENDOTEC

ANKLE JOINT METAL/POLYMER/METAL ANATOMICALLY SEMI-CONSTRAINED, CONGRUENT, MOBILE BEARING, POROUS-COATED, UNCEMENTED PROSTHESIS

Special Controls

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1. Introduction

This guidance document was developed as a special controls guidance to support the reclassification of the ankle joint metal/polymer/metal anatomically semi-constrained, congruent, mobile bearing porous-coated uncemented prosthesis into class II (special controls). The tibiotalar prosthesis includes a metal tibial and talar component, with an intermediate, fully congruent bearing consisting of a polyethylene. All of the identified metal components are porous-coated.

The devices, as classified, are intended for replacement of the tibiotalar articulation of the ankle joint. This guidance will be issued in conjunction with a Federal Register notice announcing the reclassification of these device types. Following the effective date of this final reclassification rule any firm submitting a 510(k) premarket notification for the ankle joint metal/polymer/metal anatomically semi-constrained, congruent, mobile bearing porous-coated uncemented prosthesis will need to address the issues covered in the special control guidance. However, the firm need only show that its device meets the recommendations of the guidance or in some other way provides equivalent assurances of safety and effectiveness.

2. Background

Endotec believes that special controls, when combined with the general controls, will be sufficient to provide reasonable assurance of the safety and effectiveness of the ankle joint metal/polymer/metal anatomically semi-constrained, congruent, mobile bearing porous-coated uncemented prosthesis. Thus, a manufacturer who intends to market a device of this generic type should (1) conform to the general controls of the Federal Food, Drug & Cosmetic Act (the Act), including the 510(k) requirements described in 21 CFR 807 Subpart E, (2) address the specific risks to health associated with the device identified in this guidance and, (3) obtain a substantial equivalence determination from FDA prior to marketing the device. (See also 21 CFR 807.85).

This special control document identifies the classification regulations and product codes for the ankle joint metal/polymer/metal anatomically semi-constrained, congruent, mobile bearing porous-coated uncemented prosthesis (Refer to Section 4 – **Scope**). In addition, other sections of this Class II Special Control Guidance Document list the risks to health identified by Endotec and describe measures that, if followed by manufacturers and combined with the general

controls, will generally address the risks associated with the ankle joint metal/polymer/metal anatomically semi-constrained, congruent, mobile bearing porous-coated uncemented prosthesis and lead to a timely 510(k) review and clearance. This document supplements other agency documents regarding the specific content requirements of a 510(k) submission. You should also refer to 21 CFR 807.87 and other agency documents on this topic, such as the **510(k) Manual - Premarket Notification: 510(k) - Regulatory Requirements for Medical Devices**, http://www.fda.gov/cdrh/manual/510kprt1.html.

Under "**The New 510(k) Paradigm - Alternate Approaches to Demonstrating Substantial Equivalence in Premarket Notifications; Final Guidance**,"[1] a manufacturer may submit a traditional 510(k) or has the option of submitting either an Abbreviated 510(k) or a Special 510(k). We believe an Abbreviated 510(k) provides the least burdensome means of demonstrating substantial equivalence for a new device, particularly once a Class II Special Controls Guidance Document has been issued. Manufacturers considering modifications to their own cleared devices may lessen the regulatory burden by submitting a Special 510(k).

The Least Burdensome Approach

The issues identified in this guidance document represent those that we believe need to be addressed before your device can be marketed. In developing the guidance, we carefully considered the relevant statutory criteria for Agency decision-making. We also considered the burden that may be incurred in your attempt to comply with the statutory and regulatory criteria in the manner suggested by the guidance and in your attempt to address the issues we have identified. We believe that we have considered the least burdensome approach to resolving the issues presented in the guidance document. If, however, you believe that there is a less burdensome way to address the issues, you should follow the procedures outlined in the "**A Suggested Approach to Resolving Least Burdensome Issues**" document. It is available on our Center web page at: http://www.fda.gov/cdrh/modact/leastburdensome.html.

3. The Content and Format of an Abbreviated 510(k) Submission

An Abbreviated 510(k) submission must include the required elements identified in 21 CFR 807.87, including the proposed labeling for the device sufficient to describe the device, its intended use, and the directions for its use. In an Abbreviated 510(k), FDA may consider the contents of a summary report to be appropriate supporting data within the meaning of 21 CFR 807.87(f) or (g); therefore, we recommend that you include a summary report. The report should describe how this special control guidance document was used during the device development and testing and should briefly describe the methods or tests used

and a summary of the test data or description of the acceptance criteria applied to address the risks identified in this guidance document, as well as any additional risks specific to your device. This section suggests information to fulfill some of the requirements of 807.87 as well as some other items that you should include in an Abbreviated 510(k).

Coversheet
The coversheet should prominently identify the submission as an Abbreviated 510(k) and cite the title of this Class II Special Controls Guidance Document.

Proposed labeling
Proposed labeling should be sufficient to describe the device, its intended use, and the directions for its use. (Refer to Section 9 for specific information that should be included in the labeling for devices of the types covered by this guidance document.)

Summary report
We recommend the summary report contain:

- Description of the device and its intended use. The description should include a complete discussion of the performance specifications and, when appropriate, detailed, labeled drawings of the device. (Refer to Section 5 for specific information that should be included in the device description for devices of the types covered by this guidance document.) You should also submit an "indications for use" enclosure.
- Description of device design requirements.
- Identification of the Risk Analysis method(s) used to assess the risk profile in general as well as the specific device's design and the results of this analysis. (Refer to Section 6 for the risks to health generally associated with the use of this device that FDA has identified.)
- Discussion of the device characteristics that address the risks identified in this Class II Special Controls Guidance Document, as well as any additional risks identified in your risk analysis.
- A brief description of the test method(s) you have used or intend to use to address each performance aspect identified in Sections 7-8 of this Class II Special Controls Guidance Document. If you follow a suggested test method, you may cite the method rather than describing it. If you modify a suggested test method, you may cite the method but should provide sufficient information to explain the nature of and reason for the modification. For each test, you should either (1) briefly present the data resulting from the test in clear and concise form, such as a table, **or** (2) describe the acceptance criteria that you will apply to your test results.[3] (See also 21 CFR 820.30, Subpart C - Design Controls for the Quality System Regulation.)

If any part of the device design or testing relies on a recognized standard, (1) a statement that testing will be conducted and meet specified acceptance criteria before the product is marketed, or (2) a declaration of conformity to the standard. Please note that testing must be completed before submitting a declaration of conformity to a recognized standard. (21 USC 514(c)(2)(B)). For more information, refer to the FDA guidance, **Use of Standards in Substantial Equivalence Determinations; Final Guidance for Industry and FDA**, http://www.fda.gov/cdrh/ode/guidance/1131.html.

If it is not clear how you have addressed the risks identified by Endotec, or additional risks identified through your risk analysis, additional information about aspects of the device's performance characteristic may be requested. Additional information may also be requested if it is needed to assess the adequacy of your acceptance criteria. (Under 21 CFR 807.87(l), we may request any additional information that is necessary to reach a determination regarding substantial equivalence.)

As an alternative to submitting an Abbreviated 510(k), you can submit a traditional 510(k) that provides all of the information and data required under 21 CFR 807.87 and described in this guidance. A traditional 510(k) should include all of your methods, data, acceptance criteria, and conclusions. Manufacturers considering modifications to their own cleared devices should consider submitting Special 510(k)s.

The general discussion above applies to any device subject to a special controls guidance document. The following is a specific discussion of how you should apply this Class II Special Controls Guidance Document to a premarket notification for the knee joint patellofemorotibial and femorotibial metal/polymer porous-coated uncemented prostheses.

Refer to http://www.fda.gov/cdrh/ode/indicate.html for the recommended format. If FDA makes a substantial equivalence determination based on acceptance criteria, the subject device should be tested and shown to meet these acceptance criteria before being introduced into interstate commerce. If the finished device does not meet the acceptance criteria, and thus differs from the device described in the cleared 510(k), It is recommended that submitters apply the same criteria used to assess modifications to legally marketed devices (21 CFR 807.81(a)(3)) to determine whether marketing of the finished device requires clearance of a new 510(k). See Required Elements for a Declaration of Conformity to a Recognized Standard (Screening Checklist for All Premarket Notification[510(K)] Submissions), http://www.fda.gov/cdrh/ode/reqrecstand.html.

4. Scope

The scope of this document is limited to the Ankle joint metal/polymer/metal anatomically semi-constrained, congruent, mobile bearing porous-coated uncemented prosthesis, regulation number 21 CFR §888.3210.

> §888.3120 Ankle joint metal/polymer/metal anatomically semi-constrained, congruent, mobile bearing, porous-coated, uncemented prosthesis
>
> (a) *Identification.* A three-part partial ankle joint metal/polymer/metal anatomically semi-constrained uncemented prosthesis is a device intended to be implanted for the surface replacement of the superior articulating surface of the talus and the corresponding surface of the tibia. This generic type of device includes prostheses that have a metal tibial component, a metal talar component with polished articular surfaces and sintered bead porous coating, falling within 21 CFR 888.3358 and ASTM F1147 on the fixation surfaces and an intermediate, congruent, ultra- high molecular weight polyethylene bearing. The device has no linkage across-the-joint. The device under compressive loading, limits only rotation in the frontal plane between the talar and tibial components and provides only rotation in the lateral plane between the bearing and the talar component by their respective articulating surfaces but where anterior-posterior and medial-lateral translation and axial rotation limitations of the tibia relative to the talus are provided by the natural malleolar articulations and the ankle ligaments and not by the prosthetic elements.
>
> Classification: Class II (Special Controls)

5. Device Description

You should identify your device, by regulation and product code, and include the following information:

- A description of the geometry of each component
- The dimensions for the total range of available sizes
- Engineering drawings (tibial and talar drawings should include the radii of curvature of the articulating surfaces in both frontal and saggital planes)
- A description of each surface coating (e.g. porous coating, ceramic coating)
- The minimum thickness if the ultra-high molecular weight polyethylene bearing (thickness should not be less than 3.0mm)
- The surface roughness of all surfaces, including any metallic or ceramic articulating surfaces and UHMWPe articulating surfaces
- A photograph of one size of each component
- Information on the manufacturing processes such as Hot Isostatic Press (HIP), heat treating and surface coating
- The voluntary standards to which the materials used in each component conform
- A list and brief description of any surgical instruments unique to the ankle such description describing means of achieving proper component positioning and minimization of malleolar fracture

6. Risks to Health

Endotec Inc. has identified the risks to health generally associated with the use of the Ankle joint metal/polymer/metal anatomically semi-constrained, congruent, mobile bearing prosthesis in the table below. One should conduct a risk analysis in accordance with EN 1441 to identify any other risks specific to your device.

Identified potential risks	Means to control / minimize risk
Infection **Section 9 and 10 – Sterility, Labeling**	510(k) Requirement – Sterility Adulteration Authority – GMP Sterility Misbranding Authority – ***Labeling*** Indications/Contraindications/Warnings/Precautions
Component Loosening **Sections 8 and 19 Controls, Labeling**	510 (k) Requirement – SE ***Design*** Misbranding Authority – ***Labeling*** Precautions / Warnings
Revision of Components Dislocation/Subluxation **Sections 8 and 10 Controls, Labeling**	510 (k) Requirement – SE ***Design*** 510 (k) Requirement – ***Pre-Clinical Testing*** 510 (k) Requirement – **Conformance to Material Standards** Misbranding Authority – ***Labeling*** Precautions / Warnings
Implant Failure / Fracture / Wear Osteolysis Sensitivity to Implant Materials **Sections 8 and 10 Controls, Labeling**	510 (k) Requirement – SE ***Design*** 510 (k) Requirement – **Conformance to Material Standards** 510 (k) Requirement – ***Pre-Clinical Testing*** Adulteration Authority – GMP Manufacturing and Design
Nerve impingement / damage Pain Vascular Disorders, Pulmonary Embolism **Sections 10 - Labeling**	Misbranding Authority – ***Labeling*** Precautions / Warnings
Surgical Error **Sections 10 - Labeling**	Misbranding Authority – ***Labeling*** Indications/Contraindications/Warnings/Precautions

As in any surgical procedure, there are risks involved in total joint replacement in general. Complications that may develop include: early or late infection that may result in device removal and joint fusion, blood vessels and nerves may be damaged, bones may be fractured during the procedure, the device may loosen or break, allergic reactions to the metallic components may occur, phlebitis may develop and cause possible lung problems, long term swelling may occur, and there may be delayed wound healing. Wear products may produce osteolysis with associated component migration and loosening. Some complications may cause prolonged illness, a draining wound, a need for blood transfusions, a need for further major surgery, and/or permanent pain, deformity, and inconvenience.

Very rarely some complications may be fatal. These possible complications are not unique to the proposed generic-type ankle replacement system, and may occur with any total joint replacement operation.

7. Preclinical Testing

a. Biocompatibility

These devices are permanent implants that have direct contact with bone. We recommend that you evaluate the biocompatibility of the materials in your device as described in the International Organization for Standardization (ISO) standard ISO 10993-1, "Biological Evaluation of Medical Devices Part 1: Evaluation and Testing." You should select biocompatibility tests appropriate for the duration and level of contact with your device.

If *identical* materials are used in a similar predicate device, with the same type and duration of patient contact, you may identify the predicate device in lieu of performing the biocompatibility testing.

If you cannot identify a similar predicate device that utilizes the identical materials, and the materials in your device do not conform to one of the recognized consensus standards identified in Section 7, we recommend that you evaluate the biocompatibility of the materials in your device as described in ISO 10993-1.

b. UHMWPe bearing components

Wear is a major late complication with total joint replacement. As patient longevity is increasing, it is not unreasonable to assume that an active lifespan of some patients could be in excess of 35 years after implantation. Wear and coldflow in incongruent articulating contact are characterized by excessive contact stress. It is paramount, therefore that such stresses be kept within acceptable limits if long life is to be achieved. A major manufacturer of UHMWPE recommends a limit of 10Mpa for compressive contact stresses under fluctuating load for machine applications. The limit should be lower for long-term human use.

It is, therefore, recommended that an analysis or test showing an adequately low contact stress be provided.

c. UHMWPe Material Property Characterization

For both types of prostheses, FDA recommends that you characterize the material properties of the final sterilized UHMWPe components according to the FDA guidance, *Data Requirements for Ultrahigh Molecular Weight Polyethylene (UHMWPe) Used in Orthopedic Devices*, dated March 28, 1995. This guidance is available at ***http://www.fda.gov/cdrh/ode/180.pdf***.

d. Range of Motion and Constraint

It is recommended that you provide range of motion data on the tibiotalar interface. You should include data on all modes of rotation (plantar/dorsi flexion, internal/external, eversion/inversion) and translation (medial/lateral, proximal/distal, anterior/posterior).

Since unnecessary constraints are undesirable in that they induce unnecessary forces on the device but essentially normal ankle stability is needed it is further recommended that you provide stability analysis of the tibiotalar interface. You should show that the device is essentially unconstrained in translation and axial rotation except that medial lateral translation and axial rotation are limited by normally functioning ligament and malleoli. You should also show that inversion eversion is controlled by the articulating surfaces under normal compressive load but that such motion is allowed and if it does occur congruent contact is not lost.

e. Contact Area/Stress

Contact stress can be determined via analytical or experimental methods. One experimental technique is by the Fuji-Film Method. With this approach, a pressure sensitive film is placed between the articular surfaces. Next a static, compressive load is placed on the components resulting in rupture of the pressure sensitive beads in the film. The beads contain ink and break at different stresses. Therefore, after applying a load the film can then be analyzed to determine both the contact area patch as well as the contact stress by the variation in the color of the film.

This type of test is however impractical for use with the many ankle replacement systems. This is due to the compound shape of the talar component, and the congruency of the articular surfaces. These factors will not allow the film to be controlled once placed between the components to produce the congruent contact needed in order to determine the appropriate contact stress.

On the other hand congruent shallow contact as seen in ankle device articulation are ready analyzed by classical analytical methods.

It is recommended that you provide a complete report on the contact surface area between the tibial component and bearing and between the bearing and talar component and an analysis or test showing an adequately low contact.

f. Porous Coatings

It is recommended that the porous coating have a volume porosity between 30 to 70 percent, an average pore size between 100 to 1,000 microns, interconnecting porosity, and a porous coating thickness of 500 to 1,500 microns.

If the porous coating on your device was cleared in one of your own previous 510(k)s, then no further characterization of the porous coating is needed. However, you should identify the other device and provide the 510(k) number for which clearance was received.

If the porous coating on your device was not cleared in one of your own previous 510(k)s, It isrecommended that you characterize the porous coating according to the FDA guidance, "**Guidance Document for Testing Orthopedic Implants with Modified Metallic Surfaces Apposing Bone or Bone Cement**, dated April 28, 1994. This guidance is available at http://www.fda.gov/cdrh/ode/827.pdf.

g. Titanium Articular Surface Coatings

In the literature, titanium alloy (Ti-6Al-4V) articulating surfaces have been shown to produce metallic particles resulting in an adverse tissue response and high third-body wear. Therefore, it is recommended that the titanium femoral components have a treated surface (e.g., nitrogen ion or TiN coating). In addition, it is recommended that you provide a complete test report of the wear properties of the treated titanium alloy/UHMWPe articulating couple. The results should be compared to a cobalt-chrome alloy (CoCrMo)/UHMWPe articulating couple

8. Controls

a. FDA Guidance Documents

- Guidance Document for Testing Orthopedic Implants with Modified Metallic Surfaces apposing Bone or Bone Cement
- Draft Guidance Document for the Preparation of Premarket Notification 510(k) Applications for Orthopedic Devices – The Basic Elements;

- Data Requirements for Ultra-High-Molecular-Weight Polyethylene (UHMWPe) Used in Orthopedic Devices;
- 510(k) Sterility Review Guidance and Revisions of 11/18/94 and ORDB 7/3/97 (K90-1)

b. American Society for Testing and Materials (ASTM)

- ASTM F67 Standard Specification for Unalloyed Titanium for Surgical Implant Applications;
- ASTM F75 Standard Specification for Cast Cobalt-Chromium-Molybdenum Alloy for Surgical Implant Applications;
- ASTM F136 Standard Specification for Wrought Titanium-6 Aluminium-4 Vanadium ELI (Extra Low Interstitial) Alloy for Surgical Implants Applications;
- ASTM F565 Practice for the Case and Handling of Orthopedic Implants and Instruments
- ASTM F648 Standard Specification for Ultra-High-Molecular-Weight Polyethylene Powder and Fabricated Form for Surgical Implants;
- ASTM F1044 Standard Test Method for Shear Testing of Porous Metal Coatings;
- ASTM F1108 Standard Specification for Titanium-6 Aluminium-4 Vanadium Alloy Castings for Surgical Implants;
- ASTM F1147 Standard Test Method for Tension Testing of Porous Metal Coatings;
- ASTM F1377 Standard Specification for Cobalt-28 Chromum-6 Molybdenum Powder for Coating of Orthopedic Implants;
- ASTN F1580 Standard Specification for Titanium and Titanium-6% Aluminum-4% Vanadium Alloy Powders for Coating of Surgical Implants.

c. International Organization for Standardization (ISO)

- ISO 5832-1996, "Implants for Surgery - Metallic Materials - Part 3: Wrought Titanium 6-Aluminium 4-Vanadium Alloy"
- Use of International Standard ISO – 10993, Biological Evaluation of the Medical Devices Part I: Evaluation and Testing
- EN46001 Quality Systems Medical Devices

9. Sterility

It is recommended that you provide sterilization information in accordance with the **Updated 510(k) Sterility Review Guidance K90-1; Final Guidance for Industry and FDA**, http://www.fda.gov/cdrh/ode/guidance/361.html. The device should be sterile with a sterility assurance level (SAL) of 1×10^{-6}.

10. Labeling

The 510(k) should include labeling in sufficient detail to satisfy the requirements of 21 CFR 807.87(e). The following suggestions are aimed at assisting you in preparing labeling that satisfies the requirements of 21 CFR 807.87(e).

Directions for Use

As a prescription device, the porous-coated uncemented ankle prosthesis is exempt from needing adequate directions for lay use. Nevertheless, under 21 CFR 807.87(e), we expect to see clear and concise instructions that delineate the technological features of the specific device and how the device is to be used in patients. Instructions should familiarize users who are trained in orthopedic surgery with the features of the device and how to use it in a safe and effective manner.

Intended Use/ Indications for Use for Ankle Joint Metal/Polymer/Metal, Anatomically Semi-Constrained, Congruent, Mobile Bearing Porous-Coated Uncemented Prosthesis

We recommend that you describe your intended use and indications. See the example below:

Intended to replace an ankle joint in order to relieve pain and restore knee function, for indications such as osteoarthritis; inflammatory arthritis; traumatic arthritis; varus, valgus, or deformities; and revision surgery.

Although final labeling is not required for 510(k) clearance, final labeling must also comply with the requirements of 21 CFR 801 before a medical device is introduced into interstate commerce. In addition, final labeling for prescription medical devices must comply with 21 CFR 801.109. Labeling recommendations in this guidance are consistent with the requirements of part 801.